

# **Graduate Program Guide**

**Department of Electrical and Computer Engineering**

**Northeastern University**

**Academic Year 2019-20**

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## **Acronyms**

**AY:** ApplyYourself

**CCSP:** Communications, Control, and Signal Processing

**CMPE:** Computer Engineering

**CNWS:** Computer Networks and Security

**COE:** College of Engineering

**CSYS:** Computer Systems and Software

**CVLA:** Computer Vision, Machine Learning, and Algorithms

**DF:** Dean's Fellow(ship)

**DDF:** Distinguished Dean's Fellow(ship)

**ECE:** Electrical and Computer Engineering

**ELPO:** Electromagnetics, Plasma, and Optics

**FT:** Full-time

**GAC:** Graduate Affairs Committee

**GSE:** Graduate School of Engineering

**IP:** In Progress

**MSC:** MSECE, course-only track

**MSECE:** Master of Science in Electrical and Computer Engineering

**MSMD:** Microsystems, materials, and devices

**MST:** MSECE, course-thesis track

**NU:** Northeastern University

**NUID:** Northeastern University Identification Number

**OGS:** Office of Global Services (formerly ISSI)

**PhD-BE:** PhD, BS Entry

**PhD-AE:** PhD, Advanced Entry

**PhDCE:** PhD in Computer Engineering

**PhDEE:** PhD in Electrical Engineering

**POWR:** Power Systems, Power Electronics, and Motion Control

**PT:** Part-time

**QE:** Qualifying Exam

**RA:** Research Assistant(ship)

**SH:** Semester Hour

**S/U:** Satisfactory or Unsatisfactory

**TA:** Teaching Assistant(ship)

# 1 General Information

This document provides information about graduate programs at the ECE Department, Northeastern University. Graduate students are expected to read this document, be familiar with the rules and procedures, follow them, and refer to this guide when they have questions.

## 1.1 Graduate Programs and Degrees

The ECE Department offers three main graduate programs, Master of Science in Electrical and Computer Engineering (MSECE), PhD in Electrical Engineering (PhDEE), and PhD in Computer Engineering (PhDCE). All programs can be pursued full-time or part-time (FT or PT). Applicants with a BS or MS degree in electrical engineering, or a closely related field, can apply either to the MSECE or one of the PhD programs. In other words, to apply to the PhD programs it is not required to hold an MS degree. The department also offers two programs in cooperation with the Gordon Institute of Engineering Leadership. These programs are Master of Science in Electrical and Computer Engineering Leadership (MSECEL) and MSECE with leadership certificate. MSECE with leadership certificate has the same requirements of MSECE plus additional course and projects as determined by the Gordon Institute of Engineering Leadership. The requirements of MSECEL are described in Section 5.

MS graduates, through taking depth and breadth courses in their concentration, and by completing project or thesis (if they have select the thesis track) will acquire the necessary analytical and technical knowledge, tools, and skills to address engineering problems of advanced nature in their field of study. They will be able to, analyze problems and formulate and design appropriate solutions in their specific concentration. These skills shall make them capable of using analytical, numerical, and experimental techniques to achieve these goals.

PhD graduates, through taking courses in the fields of Electrical Engineering or Computer Engineering, and by proposing a research topic, accomplishing the research goals formulated in it, and defending their dissertation will acquire the necessary analytical and technical knowledge, tools, and skills to address engineering problems of advanced nature and conduct independent research in their area of specialization. They will be able to analyze problems and formulate and design appropriate solutions, propose research ideas and topics and be able to conduct research and produce new knowledge in their field of study. They will possess skills and knowledge that makes them capable of using analytical, numerical, and experimental techniques to achieve these goals.

## 1.2 MSECE Tracks

MSECE applicants select one of the two tracks, the course-thesis track (MST) or the course-only track (MSC), when they apply for admission. Changing track is possible *after finishing one semester in the original track*. Please refer to Section 14 for details, conditions, and requirements.

## 1.3 MSECE Concentrations

MSECE applicants select one of the seven concentrations listed below at the time they apply for admission. These concentrations are:

1. Communications, Control, and Signal Processing (CCSP)
2. Computer Networks and Security (CNWS)

3. Computer Systems and Software (CSYS)
4. Computer Vision, Machine Learning, and Algorithms (CVLA)
5. Electromagnetics, Plasma, and Optics (ELPO)
6. Microsystems, Materials, and Devices (MSMD)
7. Power Systems, Power Electronics, and Motion Control (POWR)

Change of concentration is only possible *at the end of the first or second semester of study in the ECE Department*. This is done by filing a petition. Only a fraction of petitions for change of concentration are approved. Details can be found in Sections [14](#) and [10](#).

## 1.4 Description of ECE Concentrations

**Communication, Control, and Signal Processing (CCSP)** This concentration focuses on development of deterministic and stochastic methodologies and algorithms for modeling, analysis, and design of communications, control, and signal processing applications. The main areas of research strength in this concentration include communications, signal processing and robotics techniques for underwater deployment and related applications; wireless communication, coding, and information theory; biomedical signal processing, statistical and adaptive signal processing, brain-computer interface, pattern recognition and machine learning; robust, adaptive, and distributed control; image and video processing, mobile and assistive robotics; detection, estimation, localization and object tracking. Students in this concentration are trained for careers in wireless and mobile communications industry, applications of modern signal and image processing techniques to communications, control, imaging, radar, and sonar and design and analysis of robust and adaptive control systems.

**Computer Networks and Security (CNWS)** The Computer Networks and Security concentration prepares students for careers in a wide range of areas including wired/wireless network analysis and protocol design, sensor network design, and software and hardware security. Coursework includes network fundamentals, wireless communications, mobile and wireless networks, computer hardware security and computer software security. Students will learn the proper design and evaluation of wired/wireless networks, TCP/IP, Internet and OSI models, popular Internet applications (HTTP, SMTP, etc.), defensive and offensive approaches to cybersecurity, malware/attack analysis and remediation, side-channel leakage, and hardware/software hardening.

**Computer Systems and Software (CSYS)** The Computer Systems and Software concentration prepares students for careers in a wide range of areas including microprocessor design and verification, embedded hardware and software development, performance analysis and modeling, advanced computer system design and operating system design. Coursework includes computer architecture, simulation and performance evaluation, VLSI design, fault tolerant computing, operating systems and embedded design. Students will learn the proper design and implementation of both hardware and software systems, including microprocessors and graphics processors, high performance computing, computer-aided design tools, CMOS design rules, synthesis, compilers, computer arithmetic, resilient computation, advanced logic design, operating systems, power/performance analysis, hardware/software co-design.

**Computer Vision, Machine Learning, and Algorithms (CVLA)** The Computer Vision, Machine Learning, and Algorithms concentration prepares students for careers in a wide range of areas including vision systems, big data analytics and mining, vision/image processing, visualization systems and software, and general algorithmic approaches to problem solving. Coursework includes computer vision, algorithmic approaches, machine learning, pattern recognition, big data analytics and visualization. Students will study image motion and tracking; algorithmic foundations of robotics; applications of parallel and high performance algorithms; the human visual system and visual cognition; localization, mapping and navigation; and clustering and regression analysis.

**Electromagnetics, Plasma, and Optics (ELPO)** This area is concerned with the theory and applications associated with the launching, propagation, confinement, and control of electromagnetic, acoustic, and optical wave fields, and the study and applications of the interaction of such waves with matter. This concentration prepares students for careers in RF and microwave engineering, antenna engineering, radar, sonar, wavefield imaging, remote sensing, optics, photonics, acoustics, magnetics, sensors, and their applications in biomedical electronics, optical fiber and wireless communications, geophysical exploration, radioastronomy, and nanotechnology which rely on the analysis, design, and utilization of wave-based systems and components. Students specializing in this area take courses covering theory and applications of electromagnetics, acoustics, optics, magnetism, modern imaging, photonic devices, biomedical optics, and microwave circuit design.

**Microsystems, Materials, and Devices (MSMD)** Students in the Microsystems, Materials, and Devices concentration will learn fundamental theories, design approaches, fabrication methods, and measurement techniques for applications in high performance and miniaturized sensing platforms, wireless devices, biochips, energy harvesting devices, bio sensors, and a variety of other emerging products with electronic components. Students interested in careers in the industry can use standard simulation software tools and equipment. They can also participate in research focused on magnetic, ferroelectric and magnetoelectric materials; design and fabrication of micro/nano electromechanical systems (MEMS/NEMS) devices; design of analog, radio frequency, digital and mixed-signal integrated circuits; and low-power very-large-scale integration (VLSI).

**Power Systems, Power Electronics, and Motion Control (POWR)** This concentration covers areas related to secure and efficient operation of electric transmission and distribution systems as well as design, modeling, and control of power converters and renewable energy systems. Coursework includes power system analysis, unbalanced operation, power electronics, sustainable energy, electric drives, advanced power electronics, and electric machines. Students will learn how to model and analyze large scale power grids during normal operation and under faults, they will also learn about the principles of the operation of dc-dc converters, inverters, rectifiers, and ac-ac converters, as well as modulation techniques used in power electronics.

## 1.5 PhD Concentrations

PhD students can enter the PhD program either with a BS degree or with a Master's degree.

**1) Applicants with a BS degree (PhD-BE, or PhD, BS entry):** PhDCE students need to first complete Master's degree requirements in one of the three concentrations of CNWS, CSYS, or CVLA. PhDEE



students will complete their Master's program requirements in one of the four concentrations of CCSP, ELPO, MSMD, or POWR.

After finishing Master's requirements, PhDCE students will be collectively in the CMPE concentration and PhDEE students continue to be in the concentration in which they finished their Master's degree. For details of the requirements for these students see Section 6.

**2) Applicants with a Master's degree (PhD-AE or PhD, Advanced entry):** PhDCE students will be in the CMPE concentration and PhDEE students will be in one of the four concentrations of CCSP, ELPO, MSMD, or POWR. For details of the requirements for these students see Section 7.

Change of concentration and program (from PhDCE to PhDEE or vice versa, and from PhD programs to MSECE) is possible *after completing one semester in the original program/concentration*. For details see Section 14.

## 1.6 Graduate Advising

Students who are supported by Research Assistantship (RA), Dean's Fellowship (DF), and Distinguished Dean's Fellowships (DDF), are academically advised by their research advisor (i.e., the supporting faculty).

All MSC students, and those PhD and MST students who do not yet have a research advisor, will be advised on rules and regulations by Jesse Marsh ([j.marsh@northeastern.edu](mailto:j.marsh@northeastern.edu)), the student services coordinator of the ECE department, or by the student services specialists in the GSE. If needed, the students will be referred to the appropriate faculty for advice on course content.

PhD students who do not have a research advisor should find one as soon as possible. Research advisor can be any ECE tenured, tenure-track, emeritus, affiliated, and adjunct faculty. After they have the agreement of the research advisor, they complete the **PhD Research Advisor Form** and email it to Jesse Marsh ([j.marsh@northeastern.edu](mailto:j.marsh@northeastern.edu)). After submission of this form, their research advisor will also serve as their academic advisor.

MST students who have found a research advisor will also be academically advised by their research advisor. The MST research advisor can be any ECE tenured, tenure-track, emeritus, affiliated, and adjunct faculty. MST students who cannot find a research advisor have the option of changing their track to MSC after completing one semester in the ECE Department.

## 2 The ECE Graduate Curriculum

It is essential to know the meaning of **DEPTH**, **BREADTH**, and **EXCLUDED** courses in the graduate curriculum. These notions are only relevant to MSECE students and also to the PhD-BE students while they are completing their MSECE requirements.

### 2.1 Depth Courses

These courses provide depth of knowledge in one of the seven MSECE concentrations. Depth courses depend on the concentration and are listed under "Depth Courses" for each concentration (see pages 25–31). Some courses are listed as "depth course" for multiple concentrations. The Northeastern catalog also lists depth course for each concentration.

Depth course for each concentration can slightly vary depending on the year of matriculation of the student. Determination of whether a course is depth or not is based on the designation of the course in the year the student matriculated. If a course is added after the matriculation year of a student, and therefore is not listed as depth in the year the student entered the program, then designation of the course *in the semester that the student takes the course* determines whether the course is a depth course. Therefore, to determine if a course is depth for a student in the XXXX concentration, the following two steps are taken

1. Check the catalog (or the list of depth courses in the GPG) *for the year of matriculation of the student*. If the course is listed as depth under concentration XXXX, then it is a depth course.
2. If the course *is not listed in the catalog in the year of matriculation*, check the semester the student is planning to take the course. If in the catalog corresponding to that semester the course is listed as depth under concentration XXXX, then it is considered a depth course.

Depth courses can be ECE or non-ECE courses (for instance, a number of CS and MATH courses are listed under CNWS, CSYS, and CVLA as “Depth Courses”).

In order to register in a depth courses *no petition is required*; this applies to both ECE and non-ECE depth courses.

Under certain circumstances non-ECE courses which are not listed as depth course can be taken as depth if the subject matter of the course is close to the concentration of the student. For these cases a petition needs to be filed as explained in Section 10.

## 2.2 Breadth Courses

These courses are required to provide knowledge in areas besides student’s concentration. Any graduate-level course (ECE or non ECE) **that is *not* a depth course for a student’s concentration** (i.e., is not determined to be a depth courses following the two steps described in Section 2.1) can be a *potential* “Breadth Course”. Note that breadth courses are meant to provide knowledge in areas other than student’s concentration. **Therefore, courses that are depth for your concentration *cannot* be taken as breadth.**

There are two categories of breadth courses:

- 1) **Courses which are *not* listed as depth course for a student’s concentration but are listed as a depth course for another concentration:** These can be ECE or non-ECE courses. These courses can be taken as breadth and registering in them *does not require a petition*.
- 2) **Non-ECE graduate courses that are *not* depth for *any* ECE concentration:** These are usually graduate courses in a department closely related to ECE. Registration in these courses *requires filing a petition, and getting its approval, before registration in the course*. Petitions will be approved only for courses that are **distinct enough from student’s concentration**. The details of how to file a petition are explained in Section 10.

Putting it another way, the following courses can be taken as “breadth courses”:

1. Any graduate-level ECE course *that is not depth for student’s concentration*.  
For these courses a petition is *not* required.

2. Any non-ECE course that is depth for *another* ECE concentration and is not depth for *the student's* concentration.

For these courses a petition is *not* required.

3. Other graduate-level non-ECE courses *only if they are approved by petition*.

To register in these courses the student needs to file a petition and can register in the course only *after* the petition is approved.

Also note that “Excluded courses” *cannot* be taken as breadth. For definition of excluded courses see below and for their list see Section 15.9.

It should also be noted that a student cannot petition to count a depth course as breadth or a breadth course as a depth.

### 2.3 Excluded Courses

These courses *cannot* be selected as part of the MSECE program and, therefore, **cannot be petitioned**. These are generally non-ECE courses. Please see Section 15.9 for the list of excluded courses.

## 3 Checklist for MSECE Course-only Track (MSC) Students

Please use the following checklist for successful progress towards MSECE (course-only track):

- 1 Make sure that you read this document thoroughly and understand all of it. Plan a program of study for your degree based on depth and breadth requirements as explained below. When in doubt, contact Jesse Marsh at [j.marsh@northeastern.edu](mailto:j.marsh@northeastern.edu) or student services specialists in the GSE. Make sure that in your plan of study all prerequisites are taken before the time you plan to register in a course. You need to complete **32 SH of graduate-level course work** to graduate. The details are given below.
- 2 **Depth Requirements:** Refer to the list of “Depth Courses” for *your concentration* in the NU catalog for the year of your matriculation or to pages 25-31). You need to take and successfully complete **at least five** “Depth Courses” (20 SH).
- 3 **Breadth Requirements:** Graduate level courses outside your “Depth Courses”, whether in ECE or in a closely related department, can be potentially taken as “Breadth Courses”. You need to complete **at least two** “Breadth Courses” (8 SH) to graduate.

**Note 1** Courses that are listed under depth courses for your concentration **cannot be taken as breadth**, even if they are listed as depth course for another concentration.

**Note 2** All graduate level ECE courses that are not depth for your concentration can be taken as breadth. No petition is required to take these courses. Same is true for non-ECE courses that are depth for a concentration other than yours.

**Note 3** To take non-ECE courses that are not covered under Note 2, you need to file a petition *before registration in the course*. See Section 10 on how to file a petition.

**Note 4** Courses that are listed under “Excluded Courses” **cannot** be taken towards the MSECE degree. Please do not file petition to take these courses. Such petitions are automatically rejected. See Section 15.9 for the list of excluded courses.

- 4 For CCSP, ELPO, MSMD, and POWR students, the total number of non-ECE courses, *whether they are depth or breadth*, cannot exceed two courses (8 SH) . CMPE, CNWS, CSYS, and CVLA students can take up to three non-ECE courses (12 SH).
- 5 If you want to register in a CS class, you need to fill in a form at [CCIS course registration form](#). College of Computer and Information Science (CCISS) courses are open only to their own concentrations/degrees during the initial preregistration period.
- 6 You may register for EECE7400 (Special Problems in ECE, 1-4 SH) for *at most* 4 SH in your MSECE program. Registration in this course requires filing a registration override form (see Section [10](#)).
- 7 A maximum of 9 SH of graduate level course work can be transferred from other institutions. Transfer credit is subject to approval of the Graduate Affairs Committee (GAC) and requires filing a petition (see Section [10](#) on how to file a petition). You need to have a grade of at least B in transfer courses. Courses that have been previously counted towards obtaining a degree cannot be transferred. For more details see Section [13](#).
- 8 You graduate when you have successfully passed 32 SH of courses and have fulfilled the requirements as described above. To graduate you must have a cumulative GPA of at least 3.00 with no more than 8 semester hours of grades below B– in all courses applied to the degree.

#### 4 Checklist for MSECE Thesis-Course Track (MST) Students

Please use the following checklist for successful progress towards MSECE (thesis-course track):

- 1 Make sure that you read this document thoroughly and understand all of it. Plan a program of study for your degree based on depth and breadth requirements as explained below. When in doubt, if you have a research advisor, consult with him/her. If you do not yet have a research advisor contact Jesse marsh at [j.marsh@northeastern.edu](mailto:j.marsh@northeastern.edu) or student services specialists in the GSE. Make sure that in your plan of study all prerequisites are taken before the time you plan to register in a course. You need to complete **24 SH of graduate-level course work** plus **8 SH of thesis** to graduate. The details are given below.
- 2 Talk to the ECE faculty about their research interests and find a research advisor whose research matches your interests and background. Your research advisor can be any tenured, tenure-track, emeritus, affiliated, or adjunct ECE faculty. A list of ECE faculty can be found on the ECE website. After finding a research advisor, he/she will be your academic advisor as well . The deadline for finding a research advisor is *one year after your matriculation* at NEU. If you cannot find a research advisor, you need to file a petition to change to MSECE course-only track (MSC). For details see Section [14](#).
- 3 **Depth Requirements:** Refer to the list of “Depth Courses” for *your concentration* in the NU catalog for the year of your matriculation or to pages [25-31](#)). You need to take and successfully complete **at least three** “Depth Courses” (12 SH).

- 4 **Breadth Requirements:** Graduate level courses outside your “Depth Courses”, whether in ECE or in a closely related department, can be taken as “Breadth Courses”. You need to complete *at least one* “Breadth Course” (4 SH).
- Note 1** Courses that are listed under depth courses for your concentration cannot be taken as breadth, even if they are listed as depth course for another concentration.
- Note 2** All graduate level ECE courses that are not depth for your concentration can be taken as breadth. No petition is required to take these courses. Same is true for non-ECE courses that are depth for a concentration other than yours.
- Note 3** To take non-ECE courses that are not covered under Note 2, you need to file a petition *before registration in the course*. See Section 10 on how to file a petition.
- Note 4** Courses that are listed under “Excluded Courses” **cannot** be taken towards the MSECE degree. Please do not file petition to take these courses. Such petitions are automatically rejected. See Section 15.9 for the list of excluded courses.
- 5 The total number of non-ECE courses that you can take, *whether they are depth or breadth courses*, cannot be more than three courses (12 SH). This applies to all concentrations.
- 6 If you want to register in a CS class, you need to fill in a form at [CCIS course registration form](#). College of Computer and Information Science (CCISS) courses are open only to their own concentrations/degrees during the initial preregistration period.
- 7 You may register for EECE7400 (Special Problems in ECE, 1–4 SH) for *at most* 4 SH in your MSECE program. Registration in this course requires filing a registration override form (see Section 10).
- 8 A maximum of 9 SH of graduate level course work can be transferred from other institutions. Transfer credit is subject to approval of the Graduate Affairs Committee (GAC) and requires filing a petition (see Section 10 on how to file a petition). You need to have a grade of at least B in transfer courses. Courses that have been previously counted towards obtaining a degree cannot be transferred. For more details see Section 13.
- 9 **Thesis Requirements:** You need to register for 8 SH in EECE 7990 (Master’s Thesis). This is usually done in two semesters, each semester 4 SH, but can also be done in one semester for 8 SH.
- Note 1** If after taking 8 SH of EECE 7990 (Master’s Thesis), you have not yet successfully defended your thesis, you need to register each semester in EECE 7996 (Master’s Thesis Continuation, 0 SH) until you successfully defend your thesis.
- Note 2** When you are ready to defend your thesis, you need to form a “Thesis Committee” in consultation with your advisor. The Committee must have at least three members, and at least two of the members must be tenured or tenure-track ECE faculty. After successful defense of your thesis a letter grade will be assigned to EECE 7990 (Master’s Thesis). Your MS thesis defense date and location must be announced at least one week before the date of defense. The MS thesis announcement form can be found [here](#).
- Note 3**  $\LaTeX$  templates for writing MS thesis can be found [here](#).

- 10 You graduate when you have successfully defended your thesis and fulfilled your course requirements. To graduate you must have a cumulative GPA of at least 3.00 with no more than 8 semester hours of grades below B– in all courses applied to the degree.

## 5 Checklist for MSECCEL Students

Please use the following checklist for successful progress towards MSECCEL:

- 1 Make sure that you read this document thoroughly and understand all of it. In consultation with your GL advisor, plan a program of study for your degree based on depth and breadth requirements as explained below. When in doubt, contact your Gordon Leadership (GL) advisor or Jesse Marsh ([j.marsh@northeastern.edu](mailto:j.marsh@northeastern.edu)). Make sure that in your plan of study all prerequisites are taken before the time you plan to register in a course. You need to complete **16 SH of graduate-level course work** plus 16 SH of GL courses, as advised by your GL advisor, to graduate. The details for the ECE courses are given below. For GL courses and requirement please consult your GL advisor.
- 2 **Depth Requirements:** You have to select, in consultation with your GL advisor, one of the seven ECE concentrations. Refer to the list of “Depth Courses” for *your concentration* in the NU catalog for the year of your matriculation or to pages [25–31](#)). You need to take and successfully complete **at least two** “Depth Courses” (8 SH). The remaining two courses (8 SH) can be depth or breadth courses.  
  
**Note 1** If you plan to take a non-ECE breadth course that is *not* a depth course for any ECE concentration, you need to file a petition *before registration in the course*. See Section [10](#) on how to file a petition.  
**Note 2** Courses that are listed under “Excluded Courses” **cannot** be taken towards the MSECCEL degree. Please do not file petition to take these courses. Such petitions are automatically rejected. See Section [15.9](#) for the list of excluded courses.
- 3 Regardless of your concentration, from the 16 SH non GL courses that you must take, at least 12 SH must be ECE courses.
- 4 If you want to register in a CS class, you need to fill in a form at [CCIS course registration form](#). College of Computer and Information Science (CCISS) courses are open only to their own concentrations/degrees during the initial preregistration period.
- 5 You graduate when you have successfully passed 16 SH of ECE graduate courses and have fulfilled the requirements of the GL program. To graduate you must have a cumulative GPA of at least 3.00 with no more than 8 semester hours of grades below B– in all courses applied to the degree.

## 6 Checklist for PhD Students with MS Degree (PhD, Advanced entry)

- 1 If you have a research advisor, he/she will be your academic advisor as well. If you do not yet have a research advisor, you will be advised by Jesse Marsh at [j.marsh@northeastern.edu](mailto:j.marsh@northeastern.edu) until

you have found a research advisor. It is essential that you meet your academic advisor *prior to the registration period for each semester* and review your course selection with him/her.

- 2 Plan a program of study for your degree *in consultation with your academic advisor*. Make sure that all prerequisites are taken before the time you plan to register in a course.
- 3 If you do not already have a research advisor, talk to the ECE faculty about their research interests and find a research advisor whose research matches your interests and background. Your research advisor can be any tenured, tenure-track, emeritus, affiliated, or adjunct ECE faculty. A list of ECE faculty can be found on the ECE website. After finding a research advisor, complete the research advisor form found [here](#) and email it to Jesse Marsh at [j.marsh@northeastern.edu](mailto:j.marsh@northeastern.edu). Your research advisor will serve as your academic advisor. The deadline for finding a research advisor is *one year after your matriculation* at NEU. For details see Section 8.
- 4 **Course Requirements:** You need to complete at least 16 SH of graduate level course work beyond Master's degree.

**Note 1** Typically, students take more than 16 SH; usually 24 SH or more.

**Note 2** Courses are selected in consultation with your research advisor.

**Note 3** At least 8 SH of your courses must be graduate-level ECE courses.

**Note 4** If you plan to register in a non-ECE course that is *not* on the list of "Depth Courses" of any ECE concentration, you need to file a petition *before registration in the course*. Please see Section 10 on how to file a petition.

**Note 5** You may register for EECE7400 (Special Problems in ECE, 1–4 SH) for *at most* 4 SH in your PhD program. Registration in this course requires filing a petition and a registration override form (see Section 10).

**Note 6** A maximum of 9 SH of graduate level course work can be transferred from other institutions. Transfer credit is subject to approval of the Graduate Affairs Committee (GAC) and requires filing a petition (see Section 10). You need to have a grade of at least B in transfer courses. Transfer courses should not have been previously counted towards obtaining a degree.

**Note 7** To graduate you must have a cumulative GPA of at least 3.00 with no more than 8 semester hours of grades below B– in all courses applied to the degree.

- 5 **Qualifying Exam:** The ECE qualifying exam is administered once a year during the spring semester in five areas of CCSP, CMPE, ELPO, MSMD, and POWR. Full-time students (BS Entry or Advanced Entry) must take the Qualifying Exam either in the first spring or the second spring after matriculation in the PhD program. Part-time PhD students have the option of taking this exam in the third spring after matriculation in the PhD program. Failure to taking the qualifying exam by the deadline you are supposed to take it *is equivalent to failure in the exam*. For details see Section 8.

**Note 1** PhDCE students take the qualifying exam in CMPE, PhDEE students can take the exam in any of the other four concentration based on their advisor's recommendation.



- Note 2** If you do not pass the qualifying exam in your first attempt, you have to retake it the next time it is administered. This will be your last chance to pass the qualifying exam.
- Note 3** The outcome of the qualifying exam is either “pass” or “fail”.
- Note 4** After passing the qualifying exam, your status changes from “Predoctoral Student” to “PhD Candidate”. This stage is usually marked by “**Candidacy Achieved**”.
- Note 5** If you want to do research before achieving PhD candidacy (i.e., before becoming a PhD candidate as explained above), you need to register in EECE 9986 (Research, 0 SH) under your advisor’s name. Registration in this course requires filing a registration override form (see Section 10). PhD students who start the program in summer also register in this course.
- 6** You must register in EECE 9990 (Dissertation, 0 SH) for *two consecutive semesters immediately after achieving PhD candidacy*.
- Note** If after two consecutive semesters of taking EECE 9990 you have not yet defended your dissertation (this is very typical), you must register in EECE 9996 (Dissertation Continuation, 0SH) in each fall and spring semester until you successfully defend your dissertation. During the summer semester you are not required to register in EECE 9996, unless you are graduating at the end of that summer (August graduation). **If you are graduating in August you must be registered in EECE 9996 for the entire summer semester.**
- 7** **PhD Committee:** You should form your “PhD Committee” in consultation with your advisor, not later than the last day of the spring semester following the spring in which you passed the qualifying exam. For instance if you passed the qualifying exam in spring semester 2020, you have until the last day of spring semester 2021 to form your Committee. For part-time students this deadline is the last day of the second spring after passing the qualifying exam. This Committee must have at least three members of which at least two must be tenured or tenure-track ECE faculty. After forming the Committee you fill in the **PhD Committee Form** and submit it as instructed on the form. For details, see Section 8.
- 8** **Dissertation Proposal Review** (sometimes referred to as the “Comprehensive Exam” or “Proposal Defense”): The date of the Dissertation Proposal Review is determined by your research advisor and PhD Committee. This date is after you have achieved PhD candidacy, have passed the 16 SH course requirements after MS, have taken two semesters of EECE 9990, and have formed your PhD Committee. It is recommended that the Dissertation Proposal Review be scheduled within two years after passing the qualifying exam. To announce your PhD proposal review please complete and submit the **proposal review announcement form**. After successful defense of the proposal, you completes the **Dissertation Proposal Review Form**. This form is signed by your advisor and PhD committee members and emailed to Jesse Marsh ([j.marsh@northeastern.edu](mailto:j.marsh@northeastern.edu)), the student services coordinator. If the proposal review is not successful, the Committee provides recommendations on the direction of the research and arranges a date for future review. For details, see Section 8.



- Note 1** The Dissertation Proposal Review consists of a written research proposal and a presentation of it followed by a question/answer session by the PhD Committee. The presentation part of this exam is open to faculty and students.
- Note 2** Before the review, you should download the “Dissertation Proposal Review Form” from [here](#) and complete it. After the exam, this form is signed by the PhD Committee members and emailed to Jesse Marsh ([j.marsh@northeastern.edu](mailto:j.marsh@northeastern.edu)), the student services coordinator.
- 9 **Dissertation Defense:** Dissertation defense is the last stage in PhD requirements. The dissertation defense consists of a presentation of your research results followed by a question/answer session by your PhD Committee. The presentation part of this exam is open to faculty and students. **The dissertation defense must be scheduled not sooner than six months after the date of the dissertation proposal review. This is a very important scheduling restriction, please make sure to schedule your dissertation proposal review on time in order to meet this requirement.** To announce your PhD defense, please complete and submit the [dissertation defense announcement form](#). For details, see Section 8.
- 10 **Residency Requirement:** You need to be registered full-time at NU for at least two semesters after candidacy to be eligible for your degree. The two summer half-semester count as one full semester. For part-time PhD students, four semesters of part-time registration fulfills the residency requirement.
- 11 **Time Limitation:** After the establishment of degree candidacy, a maximum of five years will be allowed for the completion of the degree requirements. This time limit applies to all PhD students, PhD-BE, PhD-AE, and both PT and FT PhD students. Under extenuating circumstances, a student may request an extension of this time frame.
- 12 You graduate when you have successfully defended your dissertation and fulfilled your course and residency requirements.

For more details on stages and deadlines for PhD students see Section 8.

## 7 Checklist for PhD Students with no MS Degree (PhD, BS entry)

- 1 If you have a research advisor, he/she will be your academic advisor as well. If you do not yet have a research advisor, you will be advised by Jesse Marsh at [j.marsh@northeastern.edu](mailto:j.marsh@northeastern.edu) until you have found a research advisor. It is essential that you meet your academic advisor *prior to the registration period for each semester* and review your course selection with him/her.
- 2 Plan a program of study for your degree *in consultation with your academic advisor*. Make sure that all prerequisites are taken before the time you plan to register in a course.
- 3 If you do not already have a research advisor, talk to the ECE faculty about their research interests and find a research advisor whose research matches your interests and background. Your research advisor can be any tenured, tenure-track, emeritus, affiliated, or adjunct ECE faculty. A list of ECE faculty can be found on the ECE website. After finding a research advisor, complete and submit the research advisor form found [here](#). Your research advisor will serve

as your academic advisor. The deadline for finding a research advisor is *one year after your matriculation* at NEU. For details see Section 8.

- 4 **Course Requirements:** You need to satisfy the requirements of MSC or MST, plus the course requirements for PhD students with MS. Please refer to the corresponding sections in this document for details.

**Note 1** The decision on whether you should follow the requirements of MST or MSC is made in consultation with your research advisor.

**Note 2** PhDCE students must complete the MSECE requirements for one of the three concentrations CNWS, CSYS, CVLA (or the legacy CMPE concentration for students entering the program in fall 2015 or before). PhDEE students must complete MSECE requirements in one of the four concentrations CCSP, ELPO, MSMD, POWR.

**Note 3** After completing the requirements for MST or MSC, if interested, you can file a petition to receive an MSECE degree. You need to produce a list of the courses that you want to count towards your MS degree and attach the list to your petition. Approval of research advisor is necessary to receive the MSECE degree.

- 5 **Qualifying Exam, Dissertation Proposal Review, Dissertation Defense:** These requirements are similar to those on “Checklist for PhD Students with MS Degree”. Please refer to pages 14–17.

- 6 **Residency Requirement:** You need to be registered full-time at NU for at least two semesters after candidacy to be eligible for your degree. The two summer half-semesters count as one full semester. For part-time PhD students, four semesters of part-time registration fulfills the residency requirement.

- 7 **Time Limitation:** After the establishment of degree candidacy, a maximum of five years will be allowed for the completion of the degree requirements. This time limit applies to all PhD students, PhD-BE, PhD-AE, and both PT and FT PhD students. Under extenuating circumstances, a student may request an extension of this time frame.

For more details on stages and deadlines for PhD students see Section 8.

## 8 Stages and Deadlines in the PhD Program

The ECE PhD programs (PhDEE and PhDCE) have certain course and dissertation requirements. The course requirements depend on whether the student matriculates with a BS degree or with an MS degree. These requirements are at least 16 SH of graduate-level courses for those matriculating with MS (PhD-AE) and 40 or 48 SH for those matriculating with BS (PhD-BE); depending on whether they complete an MS thesis or not. The details of the PhD course requirements are given on pages 14–18.

The purpose of this section is to present procedures and deadlines, beyond the course requirements, needed to complete the ECE PhD degrees. These requirements are:

1. Passing the qualifying exam

2. Finding a research advisor and completing and filing the PhD Research Advisor Form found [here](#)
3. Forming the PhD committee and filing the PhD Committee Form found [here](#)
4. Completing the “Dissertation Proposal Review” stage and filing the Dissertation Proposal Review Form found here [here](#)
5. Defending the dissertation and filing it with the GSE

## 8.1 The Qualifying Exam and Candidacy Achievement

The ECE qualifying exam is administered during the spring semester in five concentrations of CCSP, CMPE, ELPO, MSMD, and POWR. Full-time PhD students (both BS Entry or Advanced Entry) have the option of taking this exam in the first or second spring after their matriculation in the PhD program. Part-time students have the option of taking the exam in their third spring semester at NU.

PhDCE students take the QE in Computer Engineering; PhDEE students can take the exam in one of the four concentrations of CCSP, EMPO, MSMD, and POWR, depending on their research focus. Students who fail the QE in their first attempt have one more chance to take the exam and must take it the first time it is administered after their first attempt. The result of the QE can be “pass” or “fail”. Upon passing the QE, the status of the student changes from “Predoctoral Student” to “PhD Candidate”. Note that “PhD student” is a general term that is used for both “Predoctoral Students” and “PhD Candidates”. After passing of the QE **PhD candidacy is achieved** by the student. After achieving PhD candidacy, the student must register in “PhD Dissertation” *in two consecutive semesters*.

Students who want to do research before achieving PhD candidacy (i.e., before becoming a PhD candidate as explained above), need to register in EECE 9986 (Research, 0 SH) under their advisor’s name. Registration in this course requires filing a registration override form (see Section 10).

An email is sent to all PhD students in early spring semester explaining the registration process for the qualifying exam.

## 8.2 Finding a Research Advisor

Students who receive financial aid in the form of research assistantship or Dean’s Fellowship have their research advisor assigned at the time of matriculation. Other students have formally a research advisor when the [PhD Research Advisor Form](#) is completed, signed by the student and the advisor, and emailed to the students services coordinator of the ECE department. The research advisor can be any tenured, tenure-track, emeritus, affiliated, or adjunct ECE faculty. All PhD students must have a research advisor within one calendar year after their matriculation at NU.

After finding a research advisor, the students should complete and submit the research advisor form found [here](#).

## 8.3 Forming the PhD Committee

The PhD committee must have at least three members, of which at least two must be tenured or tenure-track ECE faculty. After forming this committee the PhD Committee Form is completed, signed by the advisor, the Committee members, and the student, and filed as instructed on the form.

This form can be found [here](#). The deadline for filing this form is the last day of the spring semester following the spring semester in which the qualifying exam was passed. For part-time students this deadline is the last day of the second spring semester after passing the qualifying exam.

The composition of the P.D. committee can change as a result of availability of faculty, change in the direction of research, etc. After each change in the PhD committee, a new [PhD Committee Form](#) should be filed.

#### 8.4 Dissertation Proposal Review

For the dissertation proposal review, the student prepares a written research proposal and presents it orally. The presentation is open to the faculty and the students and is followed by a closed question/answer session by the PhD committee. The form to announce the presentation can be found [here](#). The main factors considered by the committee in reviewing the proposal are:

1. Merit of the proposed research as a PhD dissertation
2. Substantial evidence of progress in research
3. Knowledge of general area of research and related work
4. Ability of oral presentation of the results and answering questions related to the proposal

The date of the Dissertation Proposal Review is determined by the research advisor and the student's PhD committee. This date is after the student has achieved PhD candidacy, has passed the 16 SH course requirements after MS, has taken two semesters of EECE 9990, and has formed his/her PhD Committee. It is highly recommended that the Dissertation Proposal Review be scheduled within two years after passing the qualifying exam. **Since the dissertation defense cannot be scheduled less than six months after proposal review, it is important that students schedule their proposal review well ahead of their defense.**

After successful defense of the proposal, the student completes the Dissertation Proposal Review Form found [here](#). This form is signed by the advisor and the PhD committee and emailed to the student services coordinator. If the proposal review is not successful, the PhD committee submits written recommendations to the student on the direction of the research and arranges a date for a future review.

#### 8.5 Dissertation Defense

Dissertation defense must be scheduled **not sooner than six months after the date of the dissertation proposal review**. The form to announce dissertation defense can be found [here](#).  $\LaTeX$  templates for preparing PhD dissertation can be found [here](#).

#### 8.6 Residency Requirement

PhD students need to be registered full-time at NU for at least two semesters after achieving candidacy to be eligible for degree. The two summer half-semesters count as one full semester. For part-time PhD students, four semesters of part-time registration fulfills the residency requirement.

## 8.7 Time Limitation

After the establishment of degree candidacy, a maximum of five years will be allowed for the completion of the degree requirements. This time limit applies to all PhD students, PhD-BE, PhD-AE, and both PT and FT PhD students. Under extenuating circumstances, a student may request an extension of this time frame.

## 9 The PhD Annual Review

All PhD students are reviewed annually starting with their second year at the ECE Department. Before the review process, the student completes a form and submits a one page report of his/her progress during the past year. Based on the evaluation, the student receives a grade of “satisfactory”, “Needs Improvement”, or “unsatisfactory”. If deemed necessary, more detailed feedback is communicated to the student. The PhD annual review form can be found [here](#).

Students who receive unsatisfactory grade will be scheduled to meet with their advisor and the department Chair to receive the necessary feedback. In this meeting goals are set for next year. Students who receive “Needs Improvement” grade are encouraged to meet with their advisors and make necessary adjustments to improve their performance.

Students who receive “unsatisfactory” grades in two consecutive years are terminated from the PhD program.

## 10 Petition and Registration Override Procedures

Please note the following:

1. Petitions/overrides for taking courses must be filed and approved **BEFORE** registration in the course.
2. Filing a petition/override **does not mean that it will be approved**, you need to receive the approval to go ahead.
3. Please file your petitions/overrides well in advance. Processing a petition/override takes at least 5 business days.
4. When submitting your petition/override make sure it is completed and signed by you. If you are a PhD or MST student and have a research advisor the form must be signed by him/her as well. If the signature of the instructor is needed (for override forms), please make sure that you obtain the signature.
5. All petitions/overrides must be submitted with a pdf copy of your current transcripts. Unofficial transcripts are acceptable for this purpose.
6. The only acceptable format for petitions/overrides and transcripts is PDF. Other formats like JPEG, PNG, etc. are not acceptable.

Here are the steps for filing petitions/overrides:

1. To file a petition:
  - (a) Download the petition form from [here](#).
  - (b) Complete the form, sign it, and get other necessary signatures as described in part 4 above.
  - (c) Save the completed form as a pdf file.
  - (d) Download a copy of your current transcripts and save it as a pdf file.
  - (e) Email **both** pdf files to Jesse Marsh at [j.marsh@northeastern.edu](mailto:j.marsh@northeastern.edu). The subject of your email should be “Petition by XXX NUID YYY”, where XXX is your complete official name (first and last name as appears on your transcripts) and YYY is your NUID number. Make sure that you send your email from your husky email account.
2. To file a registration override form (these forms are used to register in courses that have restrictions, for example, EECE7674, EECE7400, EECE8986, EECE9986):
  - (a) Download the override form from [here](#).
  - (b) Complete the form and get the necessary signatures as explained in part 4 above.
  - (c) If the form is for pre-requisite waiver, get the signature of the instructor too.
  - (d) Save the completed form as a pdf file.
  - (e) Download a copy of your current transcripts and save it as a pdf file.
  - (f) Email **both** pdf files to Jesse Marsh at [j.marsh@northeastern.edu](mailto:j.marsh@northeastern.edu). The subject of your email should be “Override form from XXX NUID YYY”, where XXX is your complete official name (first and last name as appears on your transcripts) and YYY is your NUID number. Make sure that you send your email from your husky email account.
3. If you want to register in a CS class, you need to fill in a form at [CCIS course registration form](#). College of Computer and Information Science (CCISS) courses are open only to their own concentrations/degrees during the initial preregistration period.

## 11 Probation Policies and Procedures

For details please refer to the College of Engineering web site at [Probation Policies](#)

## 12 Coop and Internship Policies and Procedures

Coop and internship are forms of CPT (Curricular Practical Training) that allow full-time students to integrate a practical learning experience into their graduate program.

Internship is an option for PhD students only to provide them with work experience that is integral to the student’s education, i.e., required for their dissertation research. Internship provides the opportunity to further the students’ training and knowledge in an area central to advancement of their research. It does not refer to an “internship” as used by companies, agencies and other institutions. Examples include students working at a company, government lab or other entity whereby the tasks, data, protocols, etc. will be brought back to NU and used in an integral way in the

advisor's lab and the student's research. For more information on CPT-internship, see the [Graduate Coop](#) page.

Coop is available to **all** graduate students (MSC, MST, and PhD) and its goal is to provide students with actual work experience in their field of study and need not be research oriented (though it often is).

### **13 Policies and Procedures for Course Transfer**

Graduate students can transfer a maximum of 9 SH (or equivalent) course work from other institutions. 4 SH of course work is defined as 45 hours of lecture. For credit transfer from other institutions, the following conditions must be satisfied:

1. Student should have a grade of at least B (or equivalent) in the course.
2. The course must be passed during the past five years.
3. The course should not be part of the requirements of a degree received by the student in the past.
4. The course will be reviewed by the Graduate Affairs Committee and if recognized as a valid graduate-level course, the credit transfer is approved.

The process for transfer credit requires filing a petition (see Section [10](#)). The petition should be accompanied by the transcript of the student indicating the grade and the time the was passed, the detailed syllabus of the course (including textbook information), as well as sufficient evidence that the course has not been part of the requirements of a degree received by the student. Evidence should be noted on the transcripts *or* be sent in a letter or formal email from the Student Service Coordinator confirming credits were not used towards a degree in the former institution.

### **14 Policies and Procedures for Requesting Changes in the Graduate Program**

In general, changes to the graduate program are possible after completing at least one semester at Northeastern. This gives the students an opportunity to get accurate information about each program in order to make an informed decision. The only request for change in the program that is accepted during the first semester is change from full-time to part-time or from part-time to full-time. This change does not apply to those who hold an F-1 student visa.

1. Change from FT to PT or PT to FT. This is the only change that can be petitioned during the first semester. To request this change you need to file a petition as explained in Section [10](#). FT PhD students cannot change to PT before having a research advisor. Change from FT to PT for international students is only possible if it complies with the OGS rules.
2. Change of concentration for MS students (MSC and MST): To apply for change of concentration a minimum cumulative GPA of 3.00 is required. Full-time students have only two chances for change of concentration. Once at the end of their first semester and another chance at the

end of the second semester of study at the ECE Department. If a FT student does not apply for change of concentration at these times, or applies but his/her petition is denied, he/she will not have another opportunity to apply for change of concentration. Part-time students can apply for change of concentration as long as they have taken at least 8 and at most 16 SH of course work (excluding the “Introduction to Cooperative Education” course). To apply for change of concentration student needs to file a “Change in Degree Program/Concentration” form, which can be downloaded from [here](#), and email it with his/her transcripts to Jesse Marsh ([j.marsh@northeastern.edu](mailto:j.marsh@northeastern.edu)).

3. Change from MST to MSC: This is done by filing a petition (see Section 10) after finishing at least one semester at NU.
4. Change from MSC to MST: In addition to filing a petition (see Section 10) the student needs the approval of an ECE faculty (tenured/tenure track, emeritus, affiliated, or adjunct) to be their thesis advisor. To do this, first they get a letter or an email from the faculty clearly stating that he/she would be their thesis advisor and email it with the petition to Jesse Marsh ([j.marsh@northeastern.edu](mailto:j.marsh@northeastern.edu)).
5. Change from PhDEE to PhDCE or from PhDCE to PhDEE: The student needs to file a “Change in Degree Program/Concentration” form, which can be downloaded from [here](#), and email it with transcripts to Jesse Marsh ([j.marsh@northeastern.edu](mailto:j.marsh@northeastern.edu)). They also need to complete a new application in [Apply Yourself](#) by creating a new account and following the instruction on page 2 of the Change of Degree Program Form. Their application fee will be waived; so no payment is necessary.

If at the same time the students is also changing his/her research advisor, they also need to file a new [PhD Research Advisor Form](#).

*For International Students Only:* An approved change of program requires that a new I-20 be issued. It is the student’s responsibility to initiate the I-20 process. Instructions are provided on the official admission acceptance letter. Questions should be directed to the OGS personnel on campus.

6. Change from PhD to MS: You need to file a “Change in Degree Level” form from [here](#), and email it with your transcripts to Jesse Marsh ([j.marsh@northeastern.edu](mailto:j.marsh@northeastern.edu)). You need to get the signature of your research advisor on this form.
7. Change from MS to PhD: You need to file a “Change in Degree Level” form from [here](#), and email it with your transcripts to Jesse Marsh ([j.marsh@northeastern.edu](mailto:j.marsh@northeastern.edu)). You also need to complete a new application in [Apply Yourself](#) by creating a new account and following the instruction on page 2 of the Change of Degree Program Form. Your application fee will be waived; do not send in any payment. If an ECE faculty is willing to be your PhD advisor, please ask him/her to write a recommendation letter for you.

*For International Students Only:* An approved change of degree level from an M.S. degree to Ph.D. degree requires that a new I-20 be issued. It is the student’s responsibility to initiate the I-20 process. Instructions are provided on the official admission acceptance letter. Questions should be directed to the International Student and Scholar Institute on campus.



## **15 Depth and Excluded Courses for ECE Concentrations**

### **15.1 Depth Courses for Communication, Control, and Signal Processing (CCSP)**

EECE 5115 Dynamical Systems in Biological Engineering 4 SH  
EECE 5576 Wireless Communication Systems 4 SH  
EECE 5580 Classical Control Systems 4 SH  
EECE 5610 Digital Control Systems 4 SH  
EECE 5626 Image Processing and Pattern Recognition 4 SH  
EECE 5664 Biomedical Signal Processing 4 SH  
EECE 5666 Digital Signal Processing 4 SH  
EECE 5550 Mobile Robotics 4 SH  
EECE 5698 Special Topics: GNSS Signal Processing 4 SH  
EECE 5698 Special Topics: Feedback Control Systems: Applications to Unmanned Aerial Vehicles 4 SH  
EECE 5552 Principles of Assistive Robotics 4 SH  
EECE 7200 Linear Systems Analysis 4 SH  
EECE 7204 Applied Probability and Stochastic Processes 4 SH  
EECE 7211 Nonlinear Control 4 SH  
EECE 7213 System Identification and Adaptive Control 4 SH  
EECE 7214 Optimal and Robust Control 4 SH  
EECE 7263 Humanoid Robotics 4 SH  
EECE 7310 Modern Signal Processing 4 SH  
EECE 7311 Two Dimensional Signal and Image Processing 4 SH  
EECE 7312 Statistical and Adaptive Signal Processing 4 SH  
EECE 7323 Numerical Optimization Methods 4 SH  
EECE 7332 Error Correcting Codes 4 SH  
EECE 7335 Detection and Estimation Theory 4 SH  
EECE 7336 Digital Communications 4 SH  
EECE 7337 Information Theory 4 SH  
EECE 7346 Probabilistic System Modeling and Analysis 4 SH  
EECE 7345 Big Data and Sparsity in Control, Machine Learning, and Signal Processing 4 SH  
EECE 7398 Special Topics: Legged Robots 4 SH  
EECE 7398 Special Topics: Current Research in Nonlinear Systems 4 SH  
EECE 7398 Special Topics: Introduction to Distributed Intelligence 4 SH  
EECE 7398 Special Topics: Terahertz Communications 4 SH  
EECE 7400 Special problems in Electrical Engineering 1–4 SH

## **15.2 Depth Courses for Computer Networks and Security (CNWS)**

EECE 5155 Wireless Sensor Networks and the Internet of Things 4 SH  
EECE 5576 Wireless Communication Systems 4 SH  
EECE 5640 High Performance Computing 4 SH  
EECE 5641 Software Security 4 SH  
EECE 5698 Special Topics: Networks: Technology, Economics, Social Interactions 4 SH  
EECE 5698 Special Topics: Advanced Network Management 4 SH  
EECE 5698 Special Topics: Hardware and System Security 4 SH  
EECE 7204 Applied Probability and Stochastic Processes 4 SH  
EECE 7205 Fundamentals Computer Engineering 4 SH  
EECE 7364 Mobile and Wireless Networking 4 SH  
EECE 7374 Fundamentals of Computer Networks 4 SH  
EECE 7390 Computer Hardware Security 4 SH  
EECE 7393 Analysis and Design of Data Networks 4 SH  
EECE 7398 Special Topics: Terahertz Communications 4 SH  
EECE 7346 Probabilistic System Modeling and Analysis 4 SH  
EECE 7400 Special problems in Electrical Engineering 1-4 SH  
CS 6610 Parallel Computing 4 SH  
CY 6740 Network Security 4 SH  
CS 6750 Cryptography and Communication Security 4 SH  
CS 6754 Secure Wireless Ad-hoc Robots on Mission 1 4 SH  
CS 6760 Privacy, Security, and Usability 4 SH  
CS 6810 Distributed Algorithms 4 SH  
CS 7785 Special Topics in Network Science 4 SH

### **15.3 Depth Courses for Computer Systems and Software (CSYS)**

EECE 5552 Principles of Assistive Robotics 4 SH  
EECE 5627 Arithmetic and Circuit Design for Inexact Computing 4 SH  
EECE 5638 Compilers for Modern Computer Architectures 4 SH  
EECE 5640 High Performance Computing 4 SH  
EECE 5643 Simulation and Performance Evaluation 4 SH  
EECE 5698 Special Topics: Hardware and System Security 4 SH  
EECE 7205 Fundamentals Computer Engineering 4 SH  
EECE 7352 Computer Architecture 4 SH  
EECE 7353 VLSI Design 4 SH  
EECE 7357 Fault Tolerant Computers 4 SH  
EECE 7368 High-Level Design of HW/SW Systems 4 SH  
EECE 7376 Operating Systems: Interface and Implementation 4 SH  
EECE 7390 Computer Hardware Security 4 SH  
EECE 7398 Special Topics: Advanced Computer Architecture 4 SH  
EECE 7377 Scalable and Sustainable System Design 4 SH  
EECE 7400 Special problems in Electrical Engineering 1-4 SH  
CS 5200 Database Systems Management 4 SH  
CS 5600 Computer Systems 4 SH  
CS 6410 Compilers 4 SH  
CS 6510 Advanced Software Development 4 SH  
CS 6520 Methods of Software Development 4 SH  
CS 6610 Parallel Computing 4 SH  
CS 6810 Distributed Algorithms

#### **15.4 Depth Courses for Computer Vision, Machine Learning, and Algorithms (CVLA)**

EECE 5360 Combinatorial Optimization 4 SH  
EECE 5626 Image Processing and Pattern Recognition 4 SH  
EECE 5639 Computer Vision 4 SH  
EECE 5640 High Performance Computing 4 SH  
EECE 5642 Data Visualization 4 SH  
EECE 5644 Introduction to Machine Learning and Pattern Recognition 4 SH  
EECE 5645 Parallel Processing for Data Analytics 4 SH  
EECE 5550 Mobile Robotics 4 SH  
EECE 5554 Robotics Sensing and Navigation 4 SH  
EECE 7204 Applied Probability and Stochastic Processes 4 SH  
EECE 7205 Fundamentals Computer Engineering 4 SH  
EECE 7258 Human Sensing and Recognition 4 SH  
EECE 7313 Pattern Recognition 4 SH  
EECE 7323 Numerical Optimization Methods 4 SH  
EECE 7345 Big Data and Sparsity in Control, Machine Learning and Signal Processing 4 SH  
EECE 7352 Computer Architecture 4 SH  
EECE 7370 Advanced Computer Vision 4 SH  
EECE 7397 Advanced Machine Learning 4 SH  
EECE 7150 Autonomous field robotics 4 SH  
EECE 7400 Special Problems in Electrical Engineering 1-4 SH  
EECE 7698 Advances in Deep Learning 4 SH  
CS 5100 Foundations of Artificial Intelligence 4 SH  
CS 6110 Knowledge-based System 4 SH  
CS 6200 Information Retrieval 4 SH  
CS 6220 Data Mining Techniques 4 SH  
CS 6310 Computational Imaging 4 SH  
CS 6810 Distributed Algorithms 4 SH  
CS 7800 Advanced Algorithms 4 SH  
MATH 7232 Combinatorial Analysis 4 SH  
MATH 7233 Graph Theory 4 SH

### **15.5 Depth Courses for Electromagnetics, Plasma, and Optics (ELPO)**

EECE 5648 Biomedical Optics 4 SH  
EECE 5694 EM and Photonic Devices 4 SH  
EECE 5695 RF and Optical Antennas 4 SH  
EECE 5697 Acoustics and Sensing 4 SH  
EECE 5698 Special Topics: Electromagnetic Devices 4 SH  
EECE 5170 Introduction To Multiferroic Materials and Systems 4 SH  
EECE 7105 Optics for Engineers 4 SH  
EECE 7202 Electromagnetic Theory 1 4 SH  
EECE 7203 Complex Variable Theory and Differential Equations 4 SH  
EECE 7270 Electromagnetic Theory 2 4 SH  
EECE 7271 Computational Methods in Electromagnetics 4 SH  
EECE 7275 Antennas and Radiation 4 SH  
EECE 7276 Microwave Properties of Materials 4 SH  
EECE 7284 Optical Properties of Matter 4 SH  
EECE 7285 Optoelectronics and Fiber Optics 4 SH  
EECE 7287 Optical Detection 4 SH  
EECE 7293 Modern Imaging 4 SH  
EECE 7295 Applied Magnetism 4 SH  
EECE 7296 Electronic Materials 4 SH  
EECE 7297 Advanced Magnetic Materials 4 SH  
EECE 7298 Magnetic Materials: Fundamentals and Measurements 4 SH  
EECE 7398 Special Topics: Advanced Radio Frequency Passive Technologies 4 SH  
EECE 7400 Special problems in Electrical Engineering 1-4 SH

## **15.6 Depth Courses for Microsystems, Materials, and Devices (MSMD)**

EECE 5161 Thin Film Technologies 4 SH  
EECE 5606 Micro- and Nano-fabrication 4 SH  
EECE 5647 Nanophotonics 4 SH  
EECE 5649 CMOS Analog Integrated Circuits 4 SH  
EECE 5652 Microwave Circuits and Networks 4 SH  
EECE 5696 Energy Harvesting Systems 4 SH  
EECE 7201 Solid State Devices 4 SH  
EECE 7240 Analog Integrated Circuit Design 4 SH  
EECE 7242 Integrated Circuits for Communications & Mixed-Signal Processing 4 SH  
EECE 7243 Integrated Circuit Fabrication 4 SH  
EECE 7244 Introduction to Microelectromechanical Systems (MEMS) 4 SH  
EECE 7245 Microwave Circuit Design for Wireless Communication 4 SH  
EECE 7246 Design and Analysis of Digital Integrated Circuits 4 SH  
EECE 7247 Radio Frequency Integrated Circuit Design 4 SH  
EECE 7248 Lab section for EECE 7240 0 SH  
EECE 7250 Power Management Integrated Circuits 4 SH  
EECE 7276 Microwave Properties of Materials 4 SH  
EECE 7284 Optical Properties of Matter 4 SH  
EECE 7295 Applied Magnetism 4 SH  
EECE 7296 Electronic Materials 4 SH  
EECE 7297 Advanced Magnetic Materials 4 SH  
EECE 7298 Magnetic Materials: Fundamentals and Measurements 4 SH  
EECE 7398 Special Topics: Advanced Radio Frequency Passive Technologies 4 SH  
EECE 7353 VLSI Design 4 SH  
EECE 7400 Special problems in Electrical Engineering 1–4 SH

### **15.7 Depth Courses for Power Systems, Power Electronics, and Motion Control (POWR)**

EECE 5580 Classical Control Systems 4 SH  
EECE 5610 Digital Control Systems 4 SH  
EECE 5680 Electric Drives 1 4 SH  
EECE 5681 Lab for EECE 5680 0 SH  
EECE 5682 Power Systems Analysis 1 4 SH  
EECE 5684 Power Electronics 4 SH  
EECE 5685 Lab for EECE 5684 0 SH  
EECE 5686 Electrical Machines 4 SH  
EECE 5688 Analysis of Unbalanced Power Networks 4 SH  
EECE 5696 Energy Harvesting Systems 4 SH  
EECE 7200 Linear System Analysis 4 SH  
EECE 7211 Nonlinear Control 4 SH  
EECE 7213 System Identification and Adaptive Control 4 SH  
EECE 7214 Optimal and Robust Control 4 SH  
EECE 7220 Power System Analysis 2 4 SH  
EECE 7221 Power Systems Operation and Control 4 SH  
EECE 7224 Power System State Estimation 4 SH  
EECE 7226 Modeling of Transients in Power Systems 4 SH  
EECE 7228 Advanced Power Electronics 4 SH  
EECE 7250 Power Management Integrated Circuits 4 SH  
EECE 7323 Numerical Optimization Methods 4 SH  
EECE 7398 Special Topics: Power System Constrained Optimization 4 SH  
EECE 7400 Special problems in Electrical Engineering 1-4 SH  
ENGR 5670 Sustainable Energy: Materials, Conversion, Storage, and Usage 4 SH

## 15.8 PhD-only Courses

MS students cannot register in this course as part of their degree course requirements. PhD students can take this course as part of their beyond-MS course requirements.

EECE 7399 Preparing High Stakes Written and Oral Materials

## 15.9 Excluded Courses for All Concentrations

Excluded courses are courses that you **cannot take as part of your MSECE program**. Please *do not* petition to take these courses, any petition to take these courses will be automatically rejected. PhD students can register in excluded courses, if their advisor recommends, but if they want to receive an MSECE degree on their way to PhD, they *cannot* count these courses as part of their MSECE course requirements.

The following classes of course are excluded:

1. Courses offered by the Multidisciplinary Masters Programs (for instance, Computer Systems Engineering CSYE, Energy Systems ENSY, Engineering Management EMGT, Information Systems INFO, Sustainable Building Systems SBSY, Telecommunications Networks TELE, ...)
2. Courses offered by the engineering leadership programs
3. Certain CCIS course listed below:

CS 5010 Programming Design Paradigm 4SH

CS 5320 Digital Image Processing 4SH

CS 5330 Pattern Recognition and Computer Vision 4SH

CS 5340 Computer/Human Interaction 4SH

CS 5520 Mobile Application Development 4SH

CS 5610 Web Development 4SH

CS 5700 Computer Networks 4SH

CS 5800 Algorithms 4SH

CS 6350 Empirical Research Methods 4SH

CS 6710 Wireless Networks 4SH



## 16 Grading Guide for Special Graduate Courses

Course #	Course Title	Credits	Grading	Comments
EECE 7400*	Special Problems in EE	1-4 SH	A to C– or F	Can be taken for up to 4 SH in the MSECE and up to 4 SH in the PhD program. Usually taken as 4 SH.
EECE 7674*	Master's Project	4 SH	IP (in progress) if not completed in one semester; otherwise A to C– or F	
EECE 7990	Master's Thesis	4 or 8 SH (usually two semesters, 4 SH in each)	IP before defense, after defense changed to A to C– or F.	8 SH total, can be taken in one or two semesters.
EECE 7996	Master's Thesis Continuation	0 SH	S/U (satisfactory or unsatisfactory)	For students who, after taking 8 SH of EECE 7990, have not yet defended their MS thesis. This course maintains FT** status.
EECE 8986*	(MS) Research	0 SH	S/U	For MSECE project students who, after taking 4 SH of EECE 7674, have not yet finished their project. This course maintains FT** status.
EECE 9986*	(PhD) Research	0 SH	S/U	For PhD students who have not passed the qualifying exam but want to do research. Also PhD students who commence the program in summer should register in this course. This course maintains FT** status.
EECE 9990	Dissertation	0 SH	S/U	Taken in two consecutive semesters after passing the qualifying exam. This course maintains FT** status.
EECE 9996	Dissertation Continuation	0 SH	S/U	For PhD students that after taking two semesters of EECE 9990 have not yet defended their dissertation. This course maintains FT** status.

See next page for details

Please note the following:

- During internship students must be enrolled in one of the following courses or course combinations:
    1. EECE 9990 (PhD Dissertation, 0 SH, FT\*\* Equivalent)
    2. EECE 9996 (PhD Dissertation Continuation, , 0 SH, FT\*\* Equivalent)
    3. EECE 9986 (PhD Research, 0 SH, FT\*\* Equivalent)
    4. EECE 8986 (Master's Research, 0 SH, FT\*\* Equivalent)
    5. EECE 7990 (Master's Thesis, 4 SH) and EECE 8986 (Master's Research, 0 SH, FT\*\* Equivalent)
    6. EECE 7996 (Master's Thesis Continuation, 0 SH, FT\*\* Equivalent)
  - Students on Coop must be enrolled in EECE 6964 (Coop Work Experience, 0 SH, FT\*\* Equivalent).
  - During the summer terms, registration in these courses is for full summer *not* summer 1 or 2.
  - Continuing PhD students who have passed two semesters of EECE 9990 (PhD Dissertation) must be registered in EECE 9996 (PhD Dissertation Continuation, 0 SH, FT Equivalent) in all fall and spring semesters until they graduate. They do not need to register in this course in summer *unless they are graduating in August of that summer*. If they are graduating in August, they have to register in this course *for the entire summer semester*.
- (\*) You need to file a registration override form for this course. Please see Section [10](#). *This process needs to be repeated each semester and for all starred courses.*
- (\*\*) Registration in this course is equivalent to full-time registration.

## 17 Useful Links

- General Information Links

1. [Academic Integrity Policies](#)
2. [Code of Student Conduct](#)
3. [COE Coop Eligibility Page](#)
4. [COE Probation Policies](#)
5. [Course Descriptions](#)
6. [ECE Department website](#)
7. [ECE Graduate Studies website](#)
8. [Gordon Leadership Program](#)
9. [Graduate School of Engineering](#)
10. [NU Graduate Catalog](#)
11. [NU Graduate Students Government](#)
12. [Official University Calendars](#)
13. [Registrar's Office](#)
14. [University Health and Counseling Services](#)
15. [Office of Global Services \(OGS\)](#)

- Links to Forms

1. [Announcement form for MS Thesis Defence, PhD Proposal Review, or Dissertation Defense](#)
2. [Apply Yourself](#)
3. [Change in Degree Program/Concentration](#)
4. [Change in Degree Level](#)
5. [Dissertation Proposal Review Form](#)
6. [L<sup>A</sup>T<sub>E</sub>X templates for MS thesis and PhD dissertation](#)
7. [Petition Form](#)
8. [PhD Annual Review Form](#)
9. [PhD Committee Form](#)
10. [PhD Research Advisor Form](#)
11. [Registration Override Form](#)
12. [Various ECE Forms](#)
13. [Various Graduate School of Engineering Forms](#)